ORNITHOLOGICAL LITERATURE

Avian Energetics. By Raymond A. Paynter, Jr. (ed.). Publications of the Nuttall Ornithological Club. No. 15. Cambridge, Mass. 1974: viii + 334 pp., 57 figs., 48 tables, 1 appendix. $17.00. (Obtainable from the Nuttall Ornithological Club, c/o Museum of Comparative Zoology, Harvard Univ., Cambridge, MA 02138.)—Many ecologists are oriented toward understanding the complex environmental-organism interactions that underlie the adaptive properties of organisms. Recent reviews of the "strategies" with which organisms increase their inclusive fitness have explored how organisms might partition their time and energy in some "optimum" manner. A basic assumption is that constraints on time and energy expenditures are important determinants of the evolutionary success of a genotype. When measurement of benefits and costs is in the same units, energy or time, the potentially measurable selective forces acting on a single adaptive trait range effectively across all biologic attributes. For example, as Robert Ricklefs discusses in this volume, the question of growth rates of young birds is related to an interconnected series of factors such as food quality, foraging efficiency of the adults, predation pressure on both adults and young, the probability that the parents would do better by abandoning the present brood and trying to raise another brood later, the difficulty that the young face in finding food, and so on. These complex interactions at least theoretically become tractable when viewed in the units of the common currency, energy. The common thread through all these papers is that energetics is probably an important key to understanding ecological organization at whatever level of interest.

Fortunately for avian ecologists, comparative physiologists have refined the methods (and the actual estimates) of estimating energy expenditures of organisms. Most of this work has been principally in the laboratory and there is a growing awareness, expressed by the authors in this volume, of the need for additional refinements of the laboratory techniques for use in natural situations. The paper by James King provides a summary of available techniques of field estimates of energy expenditures and indicates their strengths and weaknesses.

As King emphasizes, the possible views that can be taken of the problem of field measurement of energy expenditures are as broad as the questions being asked by the field ecologist. Although the authors, principal discussants, and audience at the original symposium disagreed somewhat over the required detail of measurements, techniques are now available to ask questions of individual organisms in a microenvironment. William Calder's detailed analysis of the microenvironment of a nesting hummingbird verifies the importance of such a detailed approach to well-phrased questions. However, as Eugene Odum reiterates with his analogy between a microscope and a "macroscope," not all questions about energetic expenditures can be approached fruitfully at this extremely detailed level; there is a necessary compromise between specificity and generality in any biological investigation. Calder has provided nearly the complete range with his discussion of the relationships among physiological and anatomical variables related to energetics and body weight of birds. His approach to the generality of certain adaptive traits in birds, presumably limited evolutionarily by energetic constraints, provides simple predictive equations, usually logarithmic, that relate each variable to body weight, independent of species. Calder emphasizes that his equations, which bring together a diverse literature, provide a starting point for understanding species which deviate from the expected relation. The use of these equations as initial hypotheses should spur work in many areas of avian energetics.

King also generates predictive equations for total energy budgets of birds on a seasonal and daily basis. More than general statements about what ought to be happening are difficult with so few seasonal data available, a clear signal to future ornithologists of an important area of research. King is on slightly firmer empirical ground with daily energy expenditures and provides comparisons among some birds and rodents. He ends with a discussion of the data that he thinks would provide a firmer empirical base for models of the interactions of organisms with their microenvironment and with each other.

Some problems inherent in the energetic approach to understanding ecological organization and adaptive strategies are brought out forcefully by Robert Ricklefs in his first rate review of the energetic requirements of reproduction. Ricklefs is not concerned with some major aspects of energy use in reproduction, such as the mating system, pair formation, nestbuilding, and other behavioral steps leading to the actual production and growth of the young. He rather discusses the costs of the production of functional reproductive organs and eggs, incubation, and growth of the young. At each step he provides clear summaries of much of the available literature and makes detailed comparisons between distinct adaptive types, e.g., growth rates of precocial and altricial young. His essay ends with an attempt to integrate energy expenditures into the complex of adaptations by which a genotype enhances its prospects of being represented in future generations.

Each of the first 3 authors draws on physiological measurements from the laboratory and field to estimate energy expenditures. Flight, the mode of energy expenditure nearly unique to birds among vertebrates, has also been one of the most difficult to measure. The last paper in this volume, by Vance Tucker, returns to the theme of coupling laboratory and field data in assessing energetic costs of free-living birds. His essay also illustrates the importance and frustration associated with the microview of energy expenditures—importance because his theoretical calculations and wind tunnel experiments have identified important variables in flight costs, and frustration because of the many variables that must be accurately measured in a free-living bird to precisely estimate flight costs. However, Tucker provides estimates of the impact of these variables on flight cost, leaving each investigator to decide if it is essential to measure particular variables. The advances made by Tucker and C. J. Pennycuick in England in the last few years in our understanding of flight energetics are a tribute to their perceptivity and ingenuity in treating a difficult problem. They have drawn heavily from aeronautical engineering theory and find remarkably close relations between theory and data. The importance of their work to an understanding of energetic organization of ecological systems will be obvious from the number of future citations of their work.

The rapidly expanding field of avian energetics depends heavily on the earlier work of avian physiologists and ecologists, 3 of whom were principal discussants at the symposium and whose comments have been printed in full (and expanded in the case of Charles Kendeigh) following each paper. The organizer of the symposium, William Dawson, is to be congratulated on his choice of participants. He also was responsible for the extremely helpful appendix of conversion constants for the international system of units used in avian energetics.

This volume is mostly concerned with only one half of the energy equation, the expenditure of energy. Although each author was cognizant of the problem, there is almost no discussion of energy intake, especially in free-living birds, principally due to a lack of field techniques for measuring energy intake. The intake half of the energy equation will have important ramifications on how energy and time are spent by an

organism, primarily through determining how much time and energy must be allotted to maintaining energy income, and thus effectively limiting the available time and energy for other expenditures. A further difficulty, mentioned by several contributors, is the lack of information on the role of nutrient intake in determining ecological organization. In this respect the plant ecologists are far ahead of animal ecologists. However, these deficiencies point out the relative infancy and bright future of the field of avian energetics.

The speed of development of this field speaks well for the foresight of the Nuttall Ornithological Club, sponsors of the symposium, in identifying a field of ornithological inquiry that would be an important, emerging field in the 1970's. The goal of the club to lead ornithology into the 70's rather than reminisce about the past is achieved admirably with the present volume. In an emerging field it is important that results of such a symposium appear in print as soon as possible. The editor is to be congratulated for limiting publication time to about one year following the symposium, and in a volume that is remarkably free of printing errors.

To modify slightly a statement by George Bartholomew, one of the discussants, this volume will be an essential reference for all workers in the field of avian energetics and will provide important summaries for the full spectrum of biologists.—Larry L. Wolf.

The Life of Birds, 2 vols. By Jean Dorst. Translated by I. C. J. Galbraith. Columbia Univ. Press, N.Y., 1974: 718 pp., 110 text figs., 32 black-and-white photos. $35.00.—Publication of these volumes, authored by a well-known ornithologist and produced by a prestigious press, is calculated to rouse anticipation. Even the price, although one to blanche at, would seem to indicate excellence. Intentions voiced in the Introduction set an interesting stage: to concentrate "on the adaptations birds have made to the various environments they have colonized" and to produce an "essay on the ecology of birds . . . not so much for the specialist as for the well-informed public."

Reviewers, by tradition, are concerned with how well the author has fulfilled his intention. Having finished 689 pages of text, however, this reviewer regards it inappropriate to address himself entirely to this charge. More pertinent, it appears, is an evaluation of the finished "product" the press has presented the public, a public, incidentally, which has come to expect outstanding publications in biology from Columbia's press.

It has been customary to employ proofreaders to eliminate mechanical errors in manuscript proofs. Is it possible that the bibliography after each chapter was not proofread? The first chapter of Volume 2 (Chapter 19) contains 4 references which are not in the bibliography. From the next chapter one reference has been omitted and, although "Davidson (1968)" is cited twice in Chapter 21, this reference was left out. No fewer than 5 references have been omitted from the bibliography of Chapter 23. Other chapters have suffered similar careless compilation of bibliographic citations. To "well-informed" readers a bibliography has some importance.

The proofreading—or lack of it—merits further comment. How is it possible that no one entrusted with the manuscript's proof discovered that Chapter 27 is followed by Chapter 29 and the latter by 28! A column of a table (p 142) is empty of any figures. The captions for plates 8 and 9 are apparently reversed. An ornithologist would have hastened to asterisk the Pelecanoididae (p 352) to signify that this taxon is also exclusively marine. And, couldn't *someone* have corrected "*Anus*" (p 514) to *Anas*! Such editorial *faux pas* well emphasize the careless handling this manuscript has had.

Having paid the price of these volumes, the buyer might well, on inspecting the